



Eighth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Optical Communication Networks

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define Numerical Aperture (NA). Derive an expression that relates NA and core-cladding refractive index as well as NA and relative refractive index Δ . (Consider meridional rays). (08 Marks)
- b. With the help of block diagram, explain the general communication system and optical communication system. (08 Marks)
- c. A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine :
 - i) Critical angle at the core – cladding interface
 - ii) Numerical aperture for the fiber
 - iii) Acceptance angle in air for the fiber. (04 Marks)

OR

- 2 a. List the advantages of optical fiber communication. Explain any five of them. (08 Marks)
- b. By considering skew rays, obtain an expression for Numerical Aperture (NA). (08 Marks)
- c. A multimode step index fiber with a core diameter of 80 μm and a relative index difference of 1.5% is operating at a wavelength of 0.85 μm . If the core refractive index is 1.48, estimate (i) normalized frequency for fiber (ii) Number of guided modes. (04 Marks)

Module-2

- 3 a. Explain various material absorption losses in silica glass fiber. (08 Marks)
- b. Silica has a estimated fictive temperature of 1400 K with an isothermal compressibility of $7 \times 10^{-11} \text{ m}^2 \text{ N}^{-1}$. The refractive index and the photoelastic coefficient for silica are 1.46 and 0.286 respectively. Determine the theoretical attenuation in decibels per kilometer due to fundamental Rayleigh scattering in silica at optical wavelengths of 0.63 μm , 1.00 μm , 1.30 μm . (Boltzmann's constant is $1.381 \times 10^{-21} \text{ JK}^{-1}$). (08 Marks)
- c. Briefly describe Rayleigh Scattering. (04 Marks)

OR

- 4 a. With the help of diagram, explain the process of Fusion Splices. (08 Marks)
- b. Explain the working of GRIN-rod lens and fused biconical taper couplers. (08 Marks)

- c. An optical fiber has a core refractive index of 1.5. Two lengths of the fiber with smooth and perpendicular (to the core axis) end faces are perfectly aligned. Calculate the optical loss in decibels at the joint (due to Fresnel reflection) when there is a small air gap between the fiber end faces. (04 Marks)

Module-3

- 5 a. With the help of schematic, explain high-radiance surface-emitting LED and Edge-emitting double heterojunction LED. (10 Marks)
- b. Explain Fabry-Perot resonator cavity for a laser diode. (06 Marks)
- c. Briefly describe electronic recombination and the associated photon emission for direct and indirect bandgap materials. (04 Marks)

OR

- 6 a. With necessary diagram, explain reach-through avalanche photodiode. (08 Marks)
- b. Describe the front – end amplifier. (08 Marks)
- c. Briefly explain the three key transition process involved in laser action. (04 Marks)

Module-4

- 7 a. With the help of necessary representations and expressions, explain basic 2x2 Mach-Zehnder interferometer. (10 Marks)
- b. Explain the multiplexing of four wavelengths using three fiber bragg grating and three circulators. (06 Marks)
- c. Briefly describe Optical Circulators. (04 Marks)

OR

- 8 a. With simplified energy level diagram, explain amplification mechanism in Erbium-doped fiber amplifiers. (10 Marks)
- b. Explain the working of wideband optical amplifier. (06 Marks)
- c. Describe in-line amplifier and preamplifier. (04 Marks)

Module-5

- 9 a. Explain optical public telecommunication network. (10 Marks)
- b. Explain open system interconnection reference model. (10 Marks)

OR

- 10 a. Explain in detail, optical packet-switched network. (10 Marks)
- b. Explain the concept of optical burst switching. (10 Marks)

CMRIT LIBRARY
BANGALORE - 560 037
